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Federal Communications Commission
Office of Secretary

January 2, 1997

BY HAND DELIVERY

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W. Room 222
Washington, DC 20554

RE: ET Docket No. 96-102 EX PARTE PRESENTATION

Dear Mr. Caton:

AirTouch Communications, Inc., COMSAT Corporation, ICO Global Communications, Inc. (ICO), and L/Q Licensee, Inc. (LQL), are submitting this joint letter to clarify certain claims made in an ex parte presentation submitted by Apple Computer, Inc., and the Wireless Information Networks Forum (WINForum) on December 11, 1996, "Effect of NII/SUPERNet Device Deployment on Globalstar™ Capacity." These parties plan to use the 5150-5250 MHz band for feeder uplinks in global, Mobile-Satellite Service (MSS) systems.

The Apple-WINForum analysis suffers from critical flaws which vitiate its claim that deployment of 30 million NII/SUPERNet devices in the United States would not have any significant interference impact on operation of MSS feeder link systems in the 5150-5250 MHz band. In short, the analysis is not reliable because it is based on a variety of assumptions that are not necessarily accurate.

First, operation of NII/SUPERNet devices is currently undefined. There are no definitive technical standards in place for manufacture of NII/SUPERNet devices, and, consequently, no manufacturer is obligated to use the technical parameters assumed in the analysis. Apple and WINForum have sought a high degree of flexibility for design of these devices, but it is not at all clear how these devices will actually operate.

Second Apple and WINForum have ensured an overly optimistic analysis by assuming, without support, certain favorable parameters. For example:

- Apple and WINForum assume that the 30 million transmitting devices are spread evenly over the entire 350 MHz proposed for NII/SUPERNet by the FCC -- without any technical explanation for how such uniform distribution would be achieved.

- Apple and WINForum purport to analyze noise into the Globalstar™ system, but instead of using the receiver noise figure for the Globalstar™ mobile earth terminals specified in the system application, they assume their own "realistic" receiver noise figure.

- Apple and WINForum provide for an "outdoor" NII/SUPERNet device in their technical proposal, but assume -- without any predictive model -- that only 5% of the operating devices are outdoors.

If one varies the parameters underlying the Apple-WINForum analysis, then the impact on Globalstar™ and other MSS systems using the 5150-5250 MHz band, such as ICO, could be substantially more severe. To illustrate this point, we have enclosed as Exhibit 1 a table showing that the noise floor resulting from NII/SUPERNet devices transmitting in the 5150-5250 MHz band increases substantially at a Globalstar™ satellite receiver as one varies the duty cycle of the NII/SUPERNet devices and/or the number of outdoor transmitters. Both these parameters could vary within the scope of the Apple-WINForum proposal.

Apple's and WINForum's optimistic analysis does serve to point out one major difficulty faced by the MSS parties in this proceeding. There is no specification for the design of NII/SUPERNet devices or market projections for the deployment of such devices in the record. It has, therefore, been difficult for the MSS community to analyze the potential for harmful interference and to predict with any degree of certainty the net impact of widespread deployment of these unlicensed devices on licensed MSS systems using the 5150-5250 MHz band.

In addition to excluding outdoor use and limiting e.i.r.p. to 100 milliwatts per 10 MHz for NII/SUPERNet devices, a procedure for removing this uncertainty is provided in papers introduced into USA Working Groups 4-9S and 4A which propose a reasonable international regulatory limit on the use of unlicensed devices in the band. Enclosed for the record as Exhibit 2 is a copy of Document USA WP 4-9S/18 (also submitted as Document USA WP 4A/19).

This document proposes a power flux density limit on aggregate emissions within a certain area from wireless digital networks (WDN) in the band 5150-5250 MHz. The rationale for this proposal is that widespread deployment of these devices is anticipated, and interference into MSS feeder uplinks will be measured on an aggregate basis from all devices in view of the satellite receiver. Accordingly, this paper proposes a limit on the aggregate interference, which can be adhered to by all manufacturers of these unlicensed WDNs so as to avoid harmful interference into the primary service.

The objective of Document USA WP 49-S/18 is to facilitate the operation of these devices without substantially degrading the usefulness of the band for MSS feeder uplinks. We recommend that manufacturers of NII/SUPERNet devices and the MSS industry work together to develop procedures to regulate interference levels consistent with the limit set forth in Document USA WP 49-S/18 as a condition of operation of these devices in the 5150-5250 MHz band.

We have previously outlined our concerns and recommendations regarding the use of the 5150-5250 MHz band for NII/SUPERNet devices in our respective comments and reply comments in this proceeding and individual and joint ex parte presentations. Should there be any questions regarding the matters outlined above, please contact any one of the undersigned.

Respectfully submitted,

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Power Flux Density (PFD) due to a Population of 30 Million Wireless Digital Network Devices, the 5150 - 5250 MHz Band at a Mobile Satellite Service Orbit Altitude of 1414 kilometers (Globalstar System Orbit Altitude)

Duty Cycle %	#Emitters	% Outdoors %	Outdoor Emitters	Outdoor PFD dBW/MHz/m^2	Indoor PFD dBW/MHz/m^2	Total PFD dBW/MHz/m^2	Del-T/T %	Io/No dB
1%	300000	1%	3000	-126.23	-123.27	-121.49	1.78	-17.49
1%	300000	5%	15000	-119.24	-123.45	-117.84	4.13	-13.84
1%	300000	10%	30000	-116.23	-123.69	-115.51	7.08	-11.51
5%	1500000	1%	15000	-119.24	-116.28	-114.50	8.80	-10.50
5%	1500000	5%	75000	-112.25	-116.46	-110.85	20.64	-6.85
5%	1500000	10%	150000	-109.24	-116.70	-108.52	35.30	-4.52
10%	3000000	1%	30000	-116.23	-113.27	-111.49	17.81	-7.49
10%	3000000	5%	150000	-109.24	-113.45	-107.84	41.27	-3.84
10%	3000000	10%	300000	-106.23	-113.69	-105.51	70.61	-1.51
50%	15000000	1%	150000	-109.24	-106.28	-104.50	89.05	-0.50
50%	15000000	5%	750000	-102.25	-106.46	-100.85	206.37	3.15
50%	15000000	10%	1500000	-99.24	-106.70	-98.52	353.03	5.48

The Table shown above assumes that the EIRP Density of the Wireless Digital Network (WDN) devices is -20 dBW/MHz, the attenuation due to the building housing the WDN device is 17 dB, there are five 20 MHz bandwidth channels equally spaced over the 5150 - 5250 MHz band. Io/No is the interference density to noise density ratio which is a measure of interference intensity.

# of Emitters = Duty Cycle x 30 million WDN devices

Outdoor Emitters = % Outdoors x # of Emitters

Indoor PFD = EIRP Density - Spreading Loss - Building Attenuation
- 10 log(5 Channels/100 MHz) + 10 log(# of Emitters)

= -20 dBW/MHz -134 dB/square meter - 17 dB - 7 dB
+10 log(# of Emitters)

Outdoor PFD = EIRP Density - Spreading Loss - 10 log(5 Channels/100 MHz)
+ 10 log(# of Emitters)

= -20 dBW/MHz -134 dB/square meter - 7 dB
+ 10 log(# of Emitters)

No account is taken of WDN device average antenna gain or polarization loss in these calculations. It should be recognized that the Globalstar spacecraft antenna has useful gain, and thus can receive interference, from transmitters operating at elevation angles less than ten degrees. It light of this, Globalstar considers the true average gain of the population of WDN devices, including those using antennas with gains greater than 6 dBi, to be between 1 and 2 dBi. Further, in interference studies the loss due to polarization between linearly polarized and circularly polarized antennas is taken to be between 1 and 2 dB. Thus these two factors cancel each other out and are not considered in the calculation given above.

Prepared by: David E. Weinreich

David E. Weinreich
Globalstar

ITU-R FACT SHEET

Working Party: 4-9S Document:WP-4-9S/18
Date: 20 December 1996 REV.4

Document Title: Draft New Recommendation - PERMISSIBLE INTERFERENCE LIMIT FOR WIRELESS DATA NETWORKS IN THE 5150-5250 MHz BAND SHARING FREQUENCIES WITH SYSTEMS IN THE FIXED SATELLITE SERVICE

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Purpose/Objective: To create a new Recommendation that addresses the interference that could be caused to Mobile Satellite Service (MSS) Feeder Uplinks by unlicensed wireless data networks such as NII/SUPERNet or HIPERLAN.

Abstract: This document provides the text of a draft new Recommendation on interference from wireless data networks into MSS Feeder Uplinks. Consideration is being given to allocating spectrum for one unlicensed wireless data network which is referred to as NII/SUPERNet. In Europe, allocations are being considered for HIPERLANs. This paper suggests that interference from such unlicensed systems operating in MSS Feeder Uplink bands be limited by imposing Power Flux Density limits on Wireless Data Network devices.

Fact Sheet Preparer: David E. Weinreich

ITU-R FACT SHEET

Working Party: 4A Document: WP-4A/19R3
Date: 19 December 1996

Document Title: Preliminary Draft New Recommendation - PERMISSIBLE INTERFERENCE LIMIT FOR WIRELESS DATA NETWORKS OPERATING IN THE 5091 - 5250 MHZ BAND SHARING FREQUENCIES WITH SYSTEMS IN THE FIXED SATELLITE SERVICE

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Purpose/Objective: To create a Preliminary Draft New Recommendation that addresses the interference that could be caused to Mobile Satellite Service (MSS) Feeder Uplinks from non-Co-Primary or unlicensed wireless data networks such as NII/SUPERNet or HIPERLANs.

Abstract: This document provides the text for a new Recommendation on interference from non-Co-Primary or unlicensed wireless data networks into MSS Feeder Uplinks, which fall within the purview of the Fixed Satellite Service. As the basis for this working document, a study of potential interference is presented. Consideration is being given in the USA to make available spectrum for one unlicensed wireless data network which is referred to as NII/SUPERNet. In Europe allocations are being considered for HIPERLANs. This paper studies the effects of that interference from such Secondary systems operating in MSS Feeder Uplink. Methods for specifying interference criteria for these sources is investigated.

Fact Sheet Preparer: David E. Weinreich

Documents
Radiocommunication Study Groups
Working Party 4A
13 - 22 January 1997

USA WP 4A/19 R3
USA WP 4-9S/18R4
20 December 1996
Original: English

UNITED STATES OF AMERICA

PRELIMINARY DRAFT NEW RECOMMENDATION

PERMISSIBLE INTERFERENCE LIMIT FOR WIRELESS DATA NETWORKS OPERATING IN THE 5091 - 5250 MHz BAND SHARING FREQUENCIES WITH SYSTEMS IN THE FIXED SATELLITE SERVICE

1.0 Introduction

At WRC '95 the frequency band 5091 - 5250 MHz was designated for use by Non Geostationary Orbit (NGSO) Mobile Satellite Service (MSS) Feeder Links. Wireless data networks, referred to as RadioLANs or HIPERLANs, have been proposed for deployment in bands overlapping this Feeder Link allocation. Wireless data networks are characterized by wideband digital signals which are often transmitted using omni-directional antennas. Since the deployment of these data networks can be widespread and in some cases unlicensed, there is potential for significant interference to Feeder Uplinks of MSS systems.

Since, in most cases, the Wireless Data Networks will be unlicensed and secondary from the standpoint of the Table of Allocations, it is necessary to establish a permissible interference limit that will promote successful sharing between Wireless Digital Networks and MSS Feeder Uplinks.

This paper provides information and an investigation of the interference potential as a basis for a Preliminary Draft New Recommendation on interference limits from wireless data networks.

2.0 Interference Allocation

The design of a satellite system includes the allocation of impairments to the transmission links that the system will utilize. Included in these impairments are thermal noise, interference and non-linear effects such as inter-symbol interference and intermodulation. Interference impairments are considered here and include intrasystem interference due to frequency reuse and intersystem interference due to sharing frequencies with other systems and other services.

Intersystem sharing in the Fixed Satellite Service, which includes Feeder Links for Non-Geostationary Orbit Mobile Satellite Service (NGSO/MSS) systems, for digital circuits is covered by ITU-R Recommendation S.735, "Maximum Permissible Levels of Interference in a Geostationary Satellite Network for an HRDP When Forming Part of the ISDN in the Fixed Satellite Service Caused by Other Networks of this Service Below 15 GHz." This Recommendation specifies an aggregate allowable interference level of 20% of the total system noise power and a single entry interference level of 6% of the total system noise power.

In the design of satellite systems links are scaled based on the above assumptions with 6% of total system noise being allocated to as many as three other satellite systems and all other interference being allocated 2% of the total system noise power. In the case of Feeder Uplinks using the 5091 - 5250 MHz band interference sources in addition to the proposed Wireless Digital Networks (WDNs) include Out-of-Band Emissions from adjacent radiolocation transmitters, co-channel emissions from satellites using the Feeder Link frequencies in a reverse band mode (RBW) and possibly Co-Primary allocated Microwave Landing Systems. Since WDNs are proposed as unlicensed and secondary systems, for the purposes of this investigation, it is assumed that the WDNs should provisionally not be permitted to exceed an interference level of 1% of the system noise which corresponds to a $\Delta T/T$ of 1%.

3.0 Interference Calculation

Transmissions from proposed WDN systems will have nearly the same effect as thermal noise on transmissions of MSS Systems. Any interference on a Feeder Uplink will produce a decrease in quality of the S-Band MSS space-to-Earth link transmissions or a decrease in the number of S-Band MSS space-to-Earth links and a resulting decrease in system capacity. The extent of the reduction in quality or capacity is a complex function of the interference level, the demand on satellite power resources, the satellite constellation geometry and other factors.

Using the LEO-D system as an example and the characteristics of proposed WDN systems, the interference due to WDNs is computed. The quasi Iso-Flux nature of the LEO-D spacecraft 5 GHz receive antenna is such that the gain of this antenna varies so that an equivalent amount of receive power is present at the output of the antenna regardless of the magnitude of the slant range from the emitter on the surface of the earth to the spacecraft. This antenna quality

implies that an equivalent amount of interference will be received from any point on the earth that is within the coverage area of the antenna. The path loss between a user on the earth's surface and the spacecraft antenna is calculated as follows:

$$PL = 20 \log(\lambda/4\pi * SR)$$

where: λ = signal wavelength, 5 GHz=> 0.058 meters;

π = 3.14159...;

SR = Slant Range = 1414 kilometers.

The Iso-Flux nature of the LEO-D 5 GHz receive antenna makes the Slant Range appear constant regardless of the location of the interferer within the receive antenna coverage. The resulting attenuation due to this spacecraft altitude is 169.7 dB. For the purpose of this analysis, it can be assumed that the LEO-D spacecraft receive antenna has a gain of 1 dBi.

A $\Delta T/T$ of 1% implies an Interference Density-to-Noise Density ratio (Io/No) of -20 dB. The permitted interference power from WDNs can be determined, knowing that the system noise temperature for the LEO-D System is 1000K, as follows:

$\Delta T/T$ = 1% => Io/No = -20 dB

No = kT where:
k = Boltzmann's Constant -228.6 dBW/K/Hz
T = 1000K.

Hence No = -198.6 dBW/Hz and Io = -218.6 dBW/Hz or -158.6 dBW/MHz at the spacecraft receiver. The permissible total interference level at the earth's surface is computed:

I_{tot} = -158.6 dBW/MHz + Path Loss - Antenna Gain

I_{tot} = -158.6 dBW/MHz + 169.7 dB - 1 dBi

I_{tot} = 10.1 dBW/MHz or 10 dBW/MHz.

This number represents the permissible EIRP density at the earth's surface from WDNs.

The LEO-D System uses Feeder Links that will operate down to an earth station elevation angle of 10 degrees. Operation down to this elevation angle implies that the

antenna coverage area at the earth's surface has a radius of 2890 kilometers which implies an area of 26.2 million square kilometers. Although the LEO-D System operates to a minimum earth station elevation angle of 10 degrees, interference will be received from WDN systems operating at equivalent elevation angles of less than 10 degrees. This interference may have a lesser effect due to the reduced spacecraft receive antenna gain at these angles.

This aggregate EIRP density at the earth's surface can be related to an aggregate Power Flux Density at the spacecraft as follows:

$$PFD = \text{EIRP Density} - 10 \log (4\pi SR^2)$$

$$PFD = 10 \text{ dBW/MHz} - 134 \text{ dB/m}^2$$

$$PFD = -124 \text{ dBW/MHz/m}^2.$$

The following Table summarizes the parameters of WDNs.

TABLE I
Parameters for
Wireless Data Networks

	USA Typical	Europe Typical
Transmit Power	-10 dBW	-20 to 0 dBW
Channel Bandwidth	10 MHz	25 MHz

Since the majority of WDN usage will be indoors, there will some attenuation associated with the building housing the WDN device that will reduce the power of the WDN device as seen by the satellite. For this analysis this attenuation is assumed to be 17 dB. Computing as above, the PFD due to one WDN device is

$$PFD_{device} = \text{EIRP Density}_{device} - Att_{BLDG} - 134 \text{ dB/m}^2$$

$$PFD_{device} = -20 \text{ dBW/MHz} - 17 \text{ dB} - 134 \text{ dB/m}^2$$

$$PFD_{device} = -171 \text{ dBW/MHz/m}^2.$$

Different values of building attenuation will produce different device PFDs and hence affect the aggregate PFD seen by the spacecraft. Other factors that could affect the WDN PFD that were not taken into account in this simple analysis include variations in WDN device antenna gain in the direction of the MSS spacecraft, polarization coupling loss and loss due to shadowing.

The proposed European systems will occupy a larger bandwidth but due to the possibility of using increased transmit power, the power density and hence the resulting PFD due to a single device will be similar to that resulting from USA devices.

4.0 Assessment of Interference Effects

It is apparent that the amount of interference that the MSS system will see will be dependent upon the number of WDN transmitters that are active at one time and the aggregate interference level that they produce. It is the intention of the proponents of WDNs that these systems be widely deployed and unlicensed. Since these WDN devices are proposed to be widely deployed, there is a good chance that many of them will be able to be received by an MSS system and could, thus, cause significant interference. In order to permit successful sharing between WDNs and MSS Feeder Uplinks it is necessary to establish a limit on permissible interference.

Feeder Links of the MSS have been given a Primary allocation status in the 5091-5250 MHz band and will have to absorb self interference due to cross polarization frequency reuse, interference from other Feeder Link users, interference from other satellite systems using the frequency in a reverse band mode, emissions from the co-primary allocated Aeronautical Radionavigation Service and emissions from WDNs. No status has been granted with regard to the Allocation Table to WDNs, therefore, the interference that would be caused to MSS Feeder Uplinks from WDNs should be minimal.

The provisional 1% $\Delta T/T$ criterion for permissible interference from a WDN is appropriate given the ITU Allocation Table secondary or nonexistent status of unlicensed systems. This 1% $\Delta T/T$ provisional interference limit is equivalent to 1% of the spacecraft system thermal noise, an interference density to thermal noise density ratio (Io/No) of -20 dB, a Power Flux Density at a spacecraft orbit altitude of 1414 kilometers of -124 dBW/MHz/m^2 or an EIRP density at the earth's surface of 10 dBW/MHz. A Preliminary Draft New Recommendation reflecting this provisional interference limit is attached as Annex 1.

5.0 Conclusions

This contribution has examined the potential for interference to MSS Feeder Uplinks from Wireless Data Networks operating in the 5091 - 5250 MHz band. It has been

shown that WDN transmissions have the potential to cause significant interference to MSS Feeder Uplinks. An aggregate interference limit of 1% $\Delta T/T$ has provisionally been suggested for WDNs in order to prevent interference to MSS Feeder Uplinks. A Preliminary Draft New Recommendation has been included as Annex 1.

ANNEX 1

PRELIMINARY DRAFT NEW RECOMMENDATION
S.IWD

INTERFERENCE LIMITS FOR WIRELESS
DIGITAL NETWORKS OPERATING IN THE 5091 - 5250 MHz BAND
SHARING FREQUENCIES WITH THE FIXED SATELLITE SERVICE

(Questions 244/4 and 32-2/4)

The ITU-R,

CONSIDERING

(a) that systems in the Fixed Satellite Service may share frequency bands with non-Co-Primary or unlicensed wireless digital networks in the range above 1 GHz;

(b) that non-Co-Primary or unlicensed wireless digital networks that would be widely deployed possibly without the benefit of coordination among Administrations or system operators have been proposed to share frequencies with the Fixed Satellite Service;

(c) that interference from the proposed wireless digital networks would degrade the performance of a satellite system relative to its performance in the absence of sharing with these networks;

(d) that wideband interference has an effect on communications carriers similar to that of additional thermal noise;

(e) that it is necessary to determine the maximum allowable interfering RF power in a satellite system to establish the maximum transmitter power and maximum transmitted power density of wireless digital network devices,

RECOMMENDS

1. that non-Co-Primary or unlicensed wireless digital networks sharing the same frequency bands with the Fixed Satellite Service be designed in such a manner that the interference to communication carriers be provisionally limited to an aggregate $\Delta T/T$ of no more than 1% in the

direction of the spacecraft for spacecraft using full earth coverage receive antennas (see Note 1).

Note 1 - An aggregate $\Delta T/T$ of 1% is equivalent to 1% of the spacecraft system thermal noise, an interference density to thermal noise density ratio (Io/No) of -20 dB, a Power Flux Density at a spacecraft orbit altitude of 1414 kilometers of -124 dBW/MHz/m^2 or an EIRP density at the earth's surface of 10 dBW/MHz. With a Non-Geostationary Satellite System operating down to an elevation angle of 10 degrees, this EIRP would be spread over an earth surface area of 26.2 million square kilometers.